Prior Art Decision Automation & Optimization

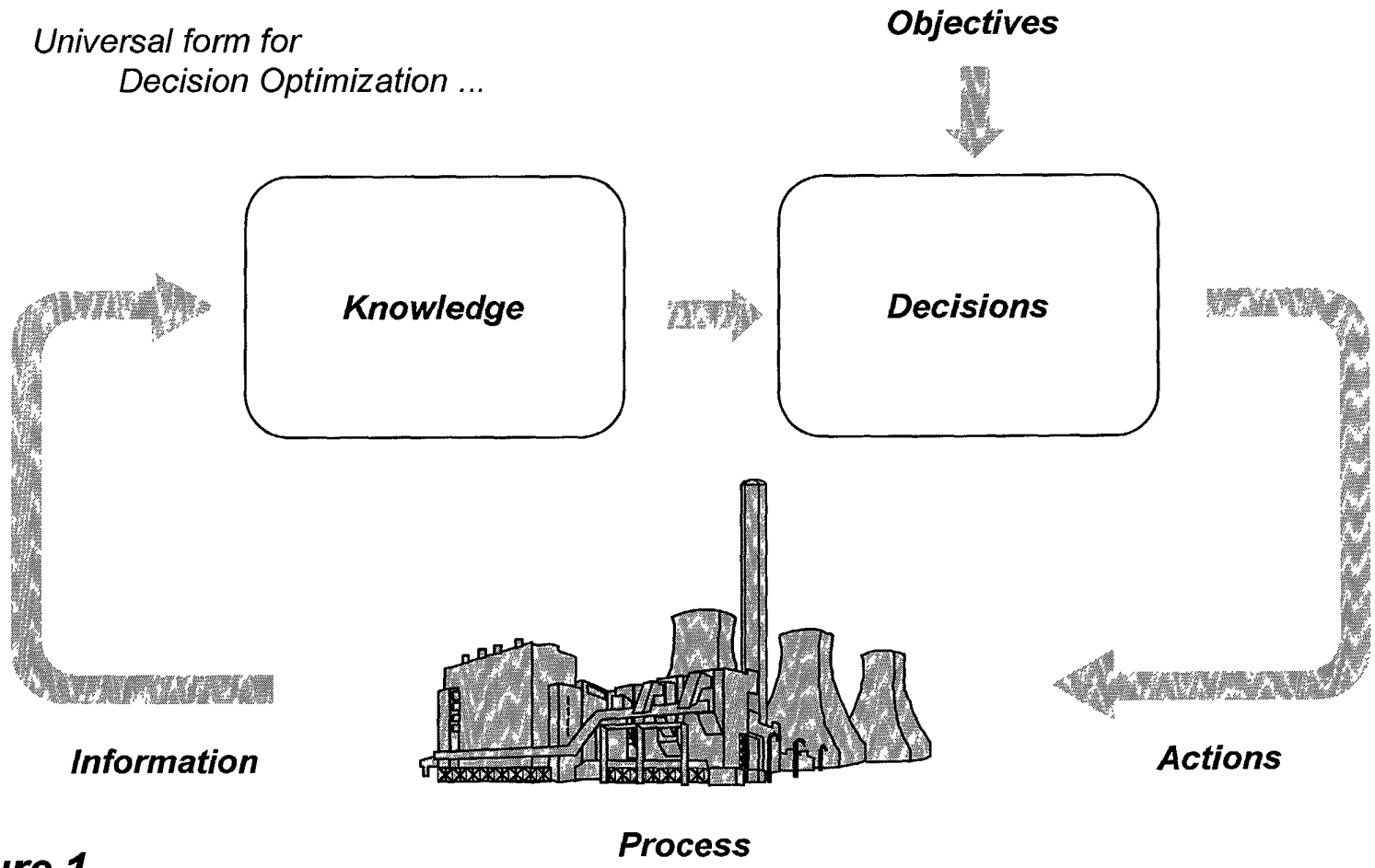


Figure 1

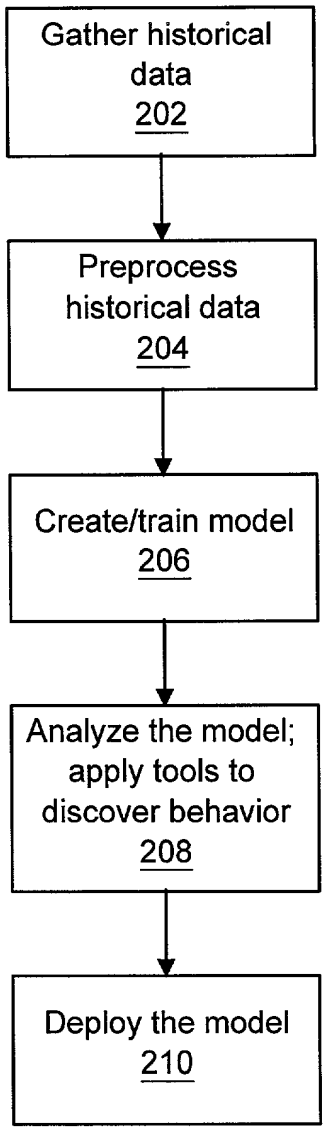


Figure 2
(Prior art)

Many Types of Decisions

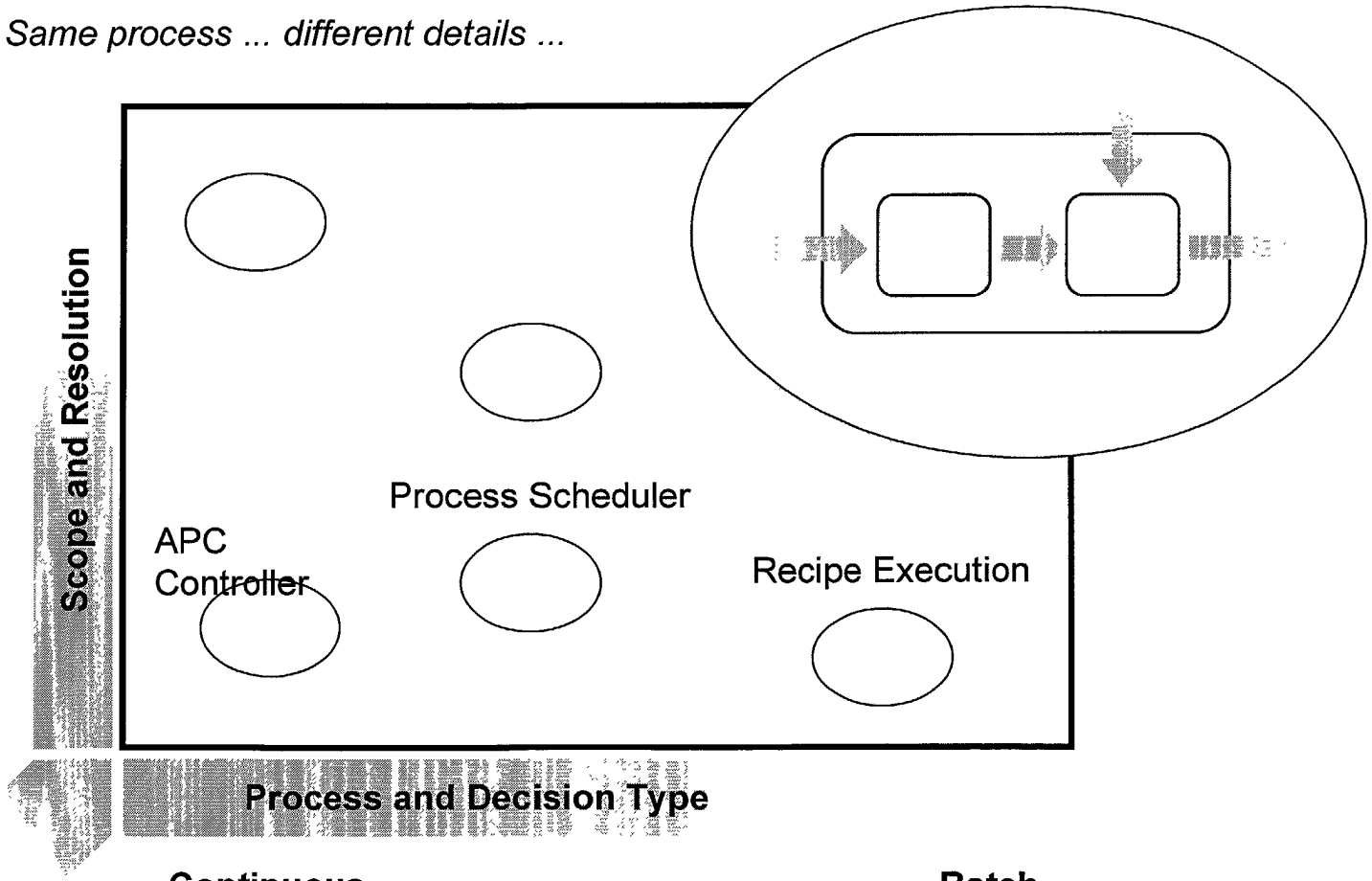


Figure 3
(Prior art)

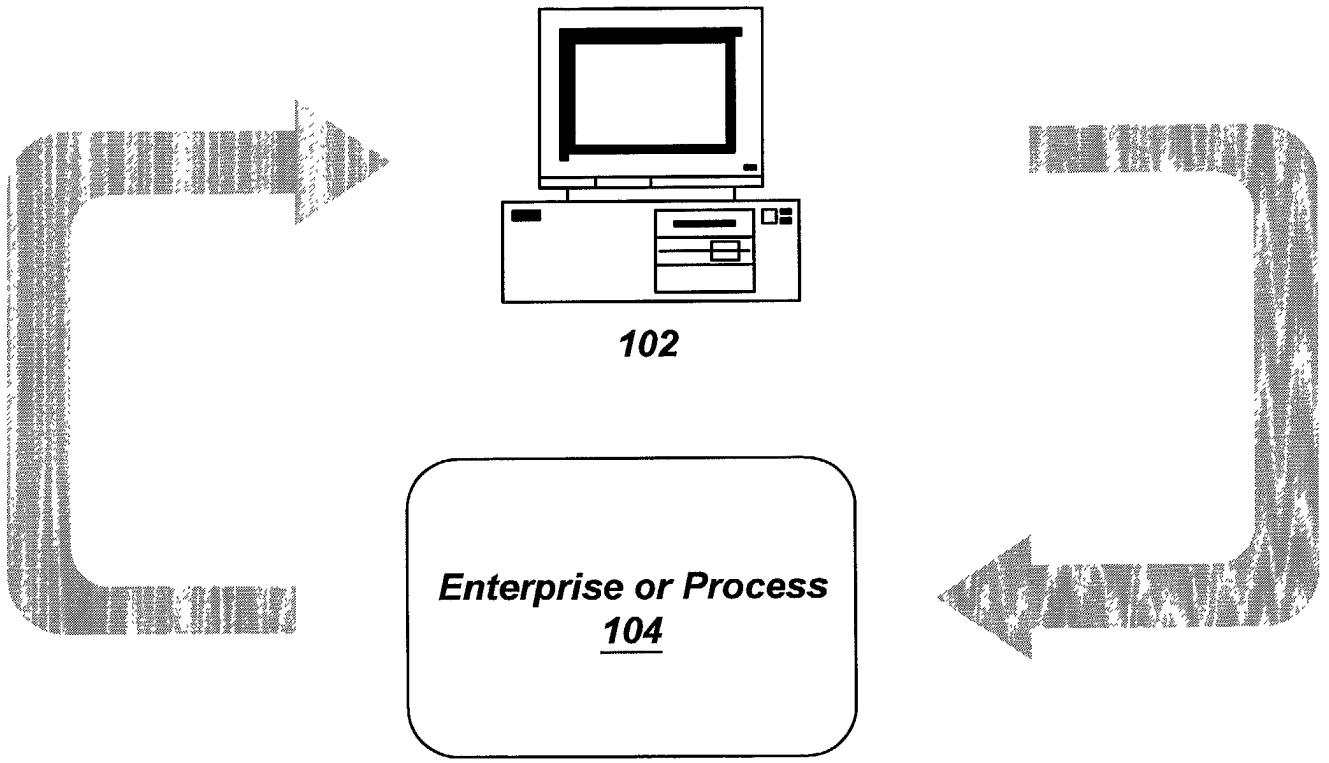


Figure 4

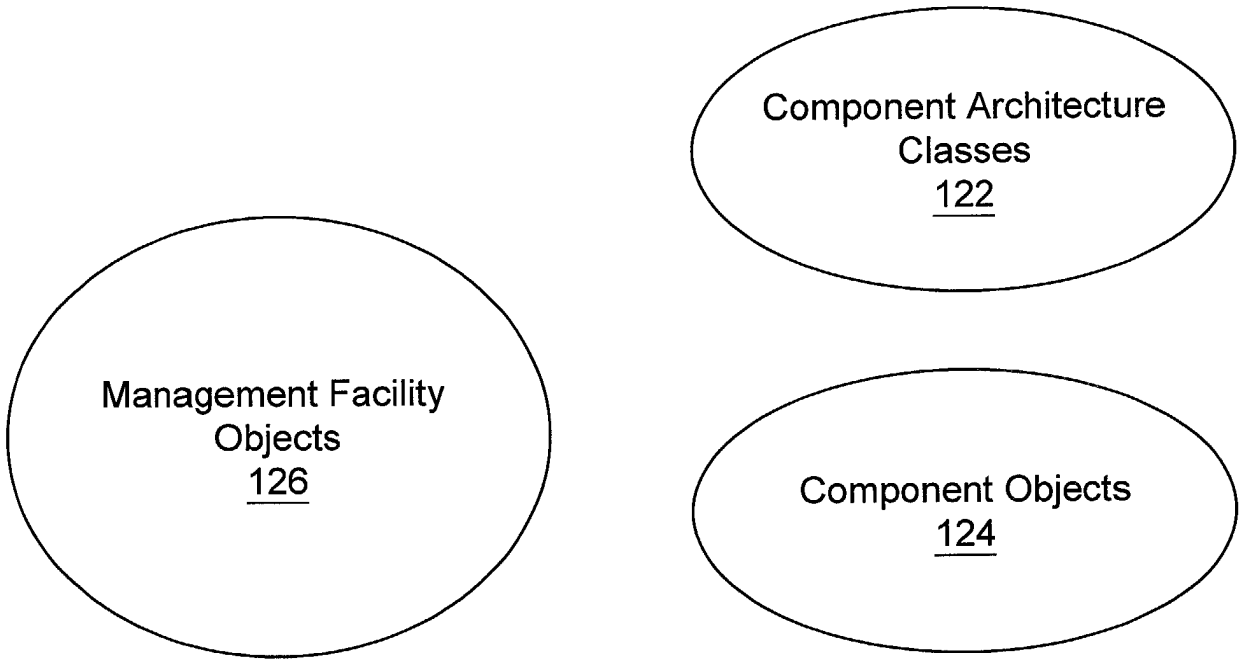

Component Architecture
Classes
122
Management Facility
Objects
126
Component Objects
124

Figure 5

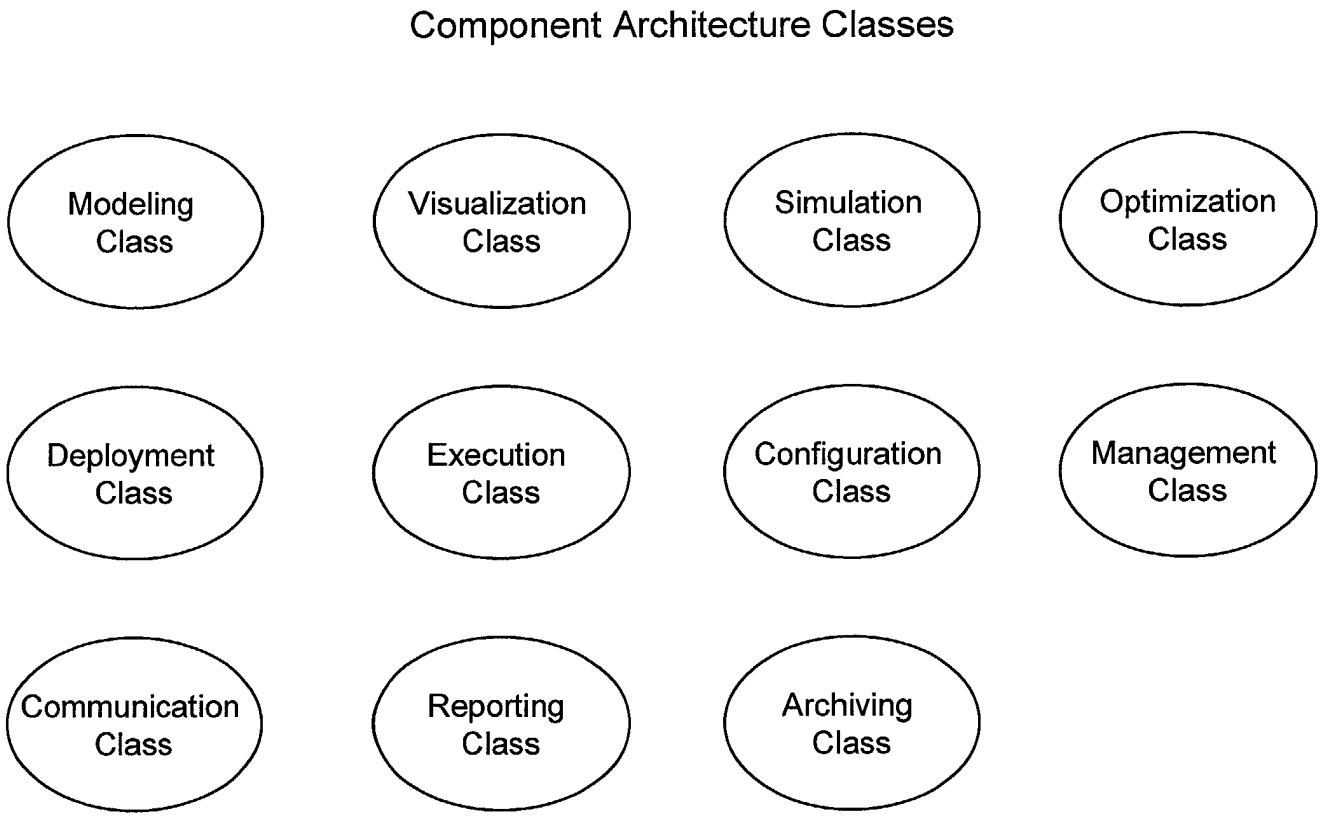

Component Architecture Classes
Modeling Class
Visualization Class
Simulation Class
Optimization Class
Deployment Class
Execution Class
Configuration Class
Management Class
Communication Class
Reporting Class
Archiving Class

Figure 6

Encapsulated Decision Engine

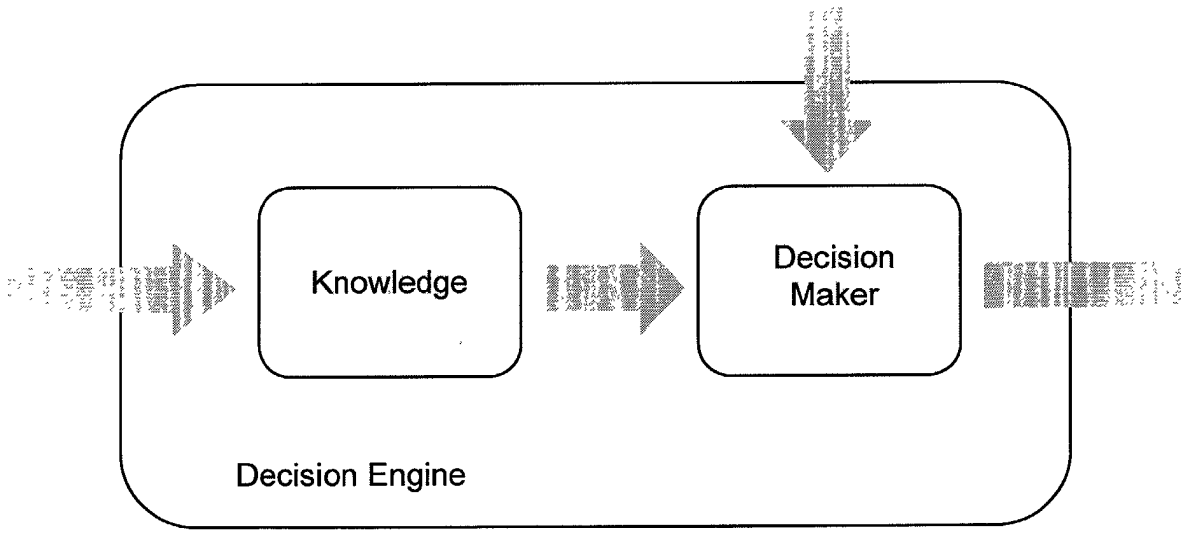
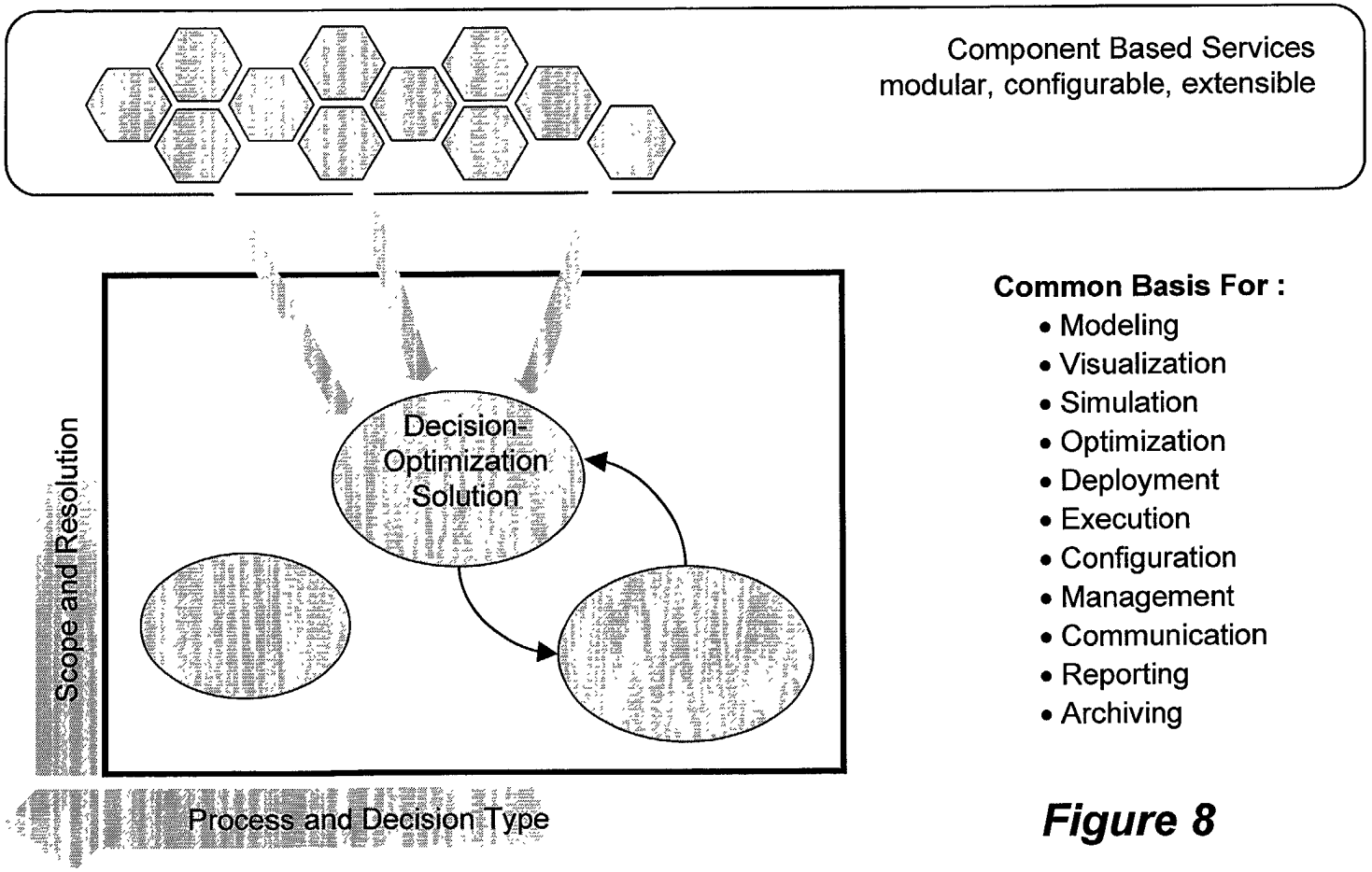


Figure 7

Component Architecture of the Preferred Embodiment



Common Basis For :

- Modeling
- Visualization
- Simulation
- Optimization
- Deployment
- Execution
- Configuration
- Management
- Communication
- Reporting
- Archiving

Figure 8

Unified Approach

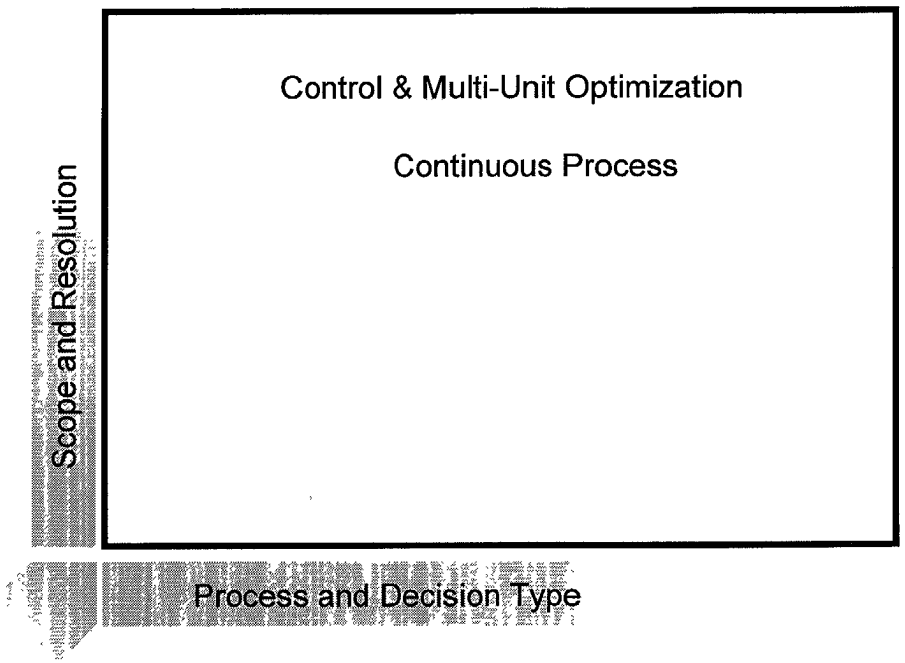
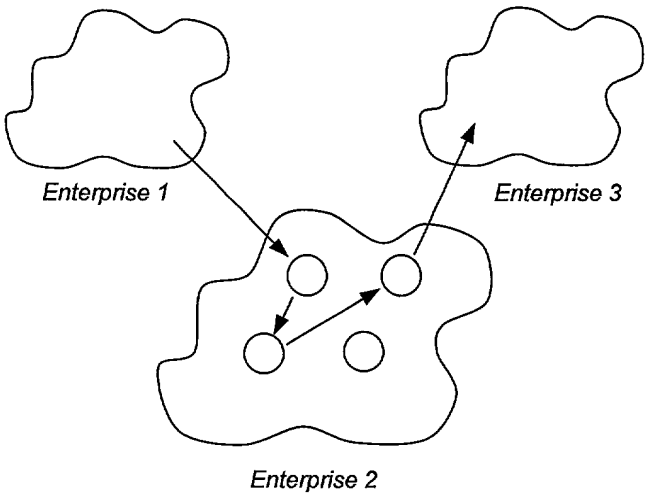


Figure 9



Events Between Enterprises

Figure 10

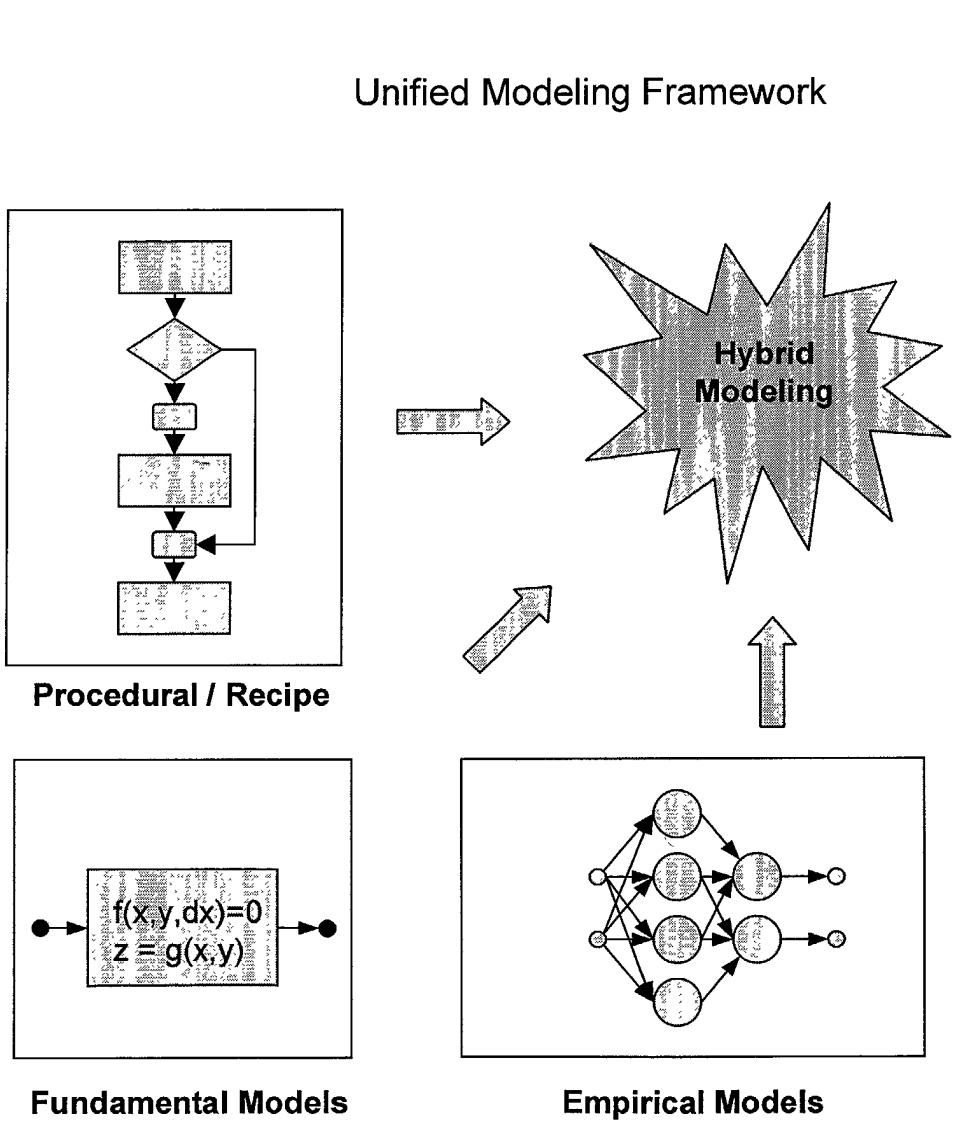
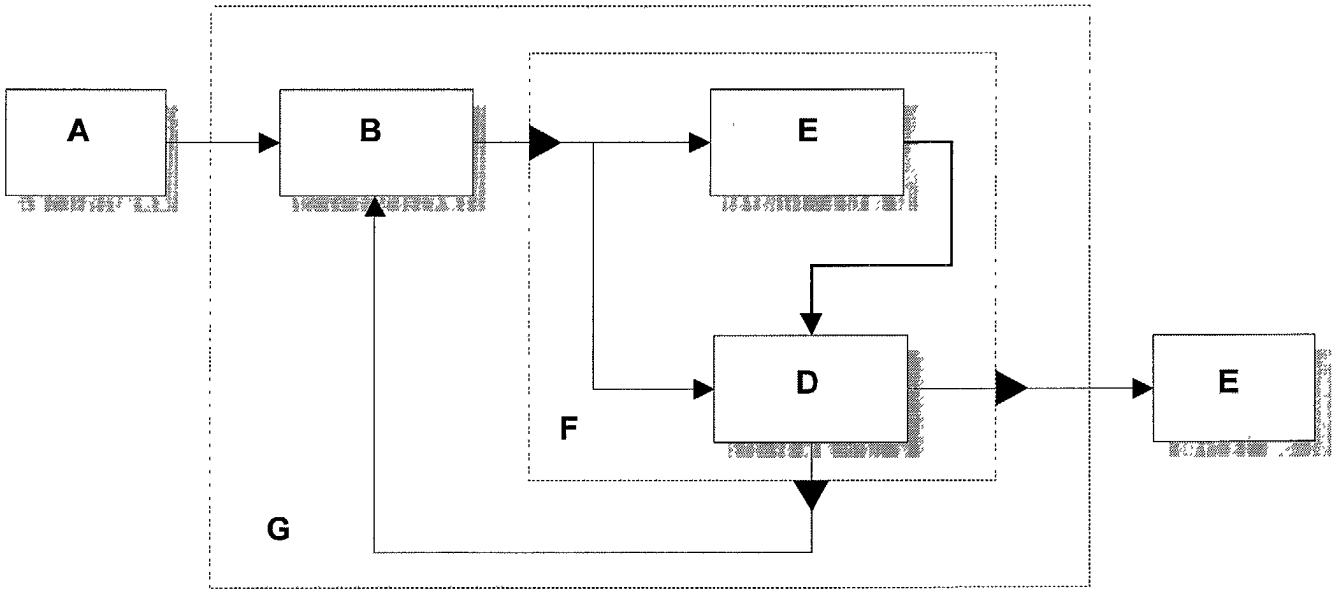

Unified Modeling Framework
Hybrid Modeling
Procedural / Recipe
f(x,y,dx)=0
z = g(x,y)
Fundamental Models
Empirical Models

Figure 11

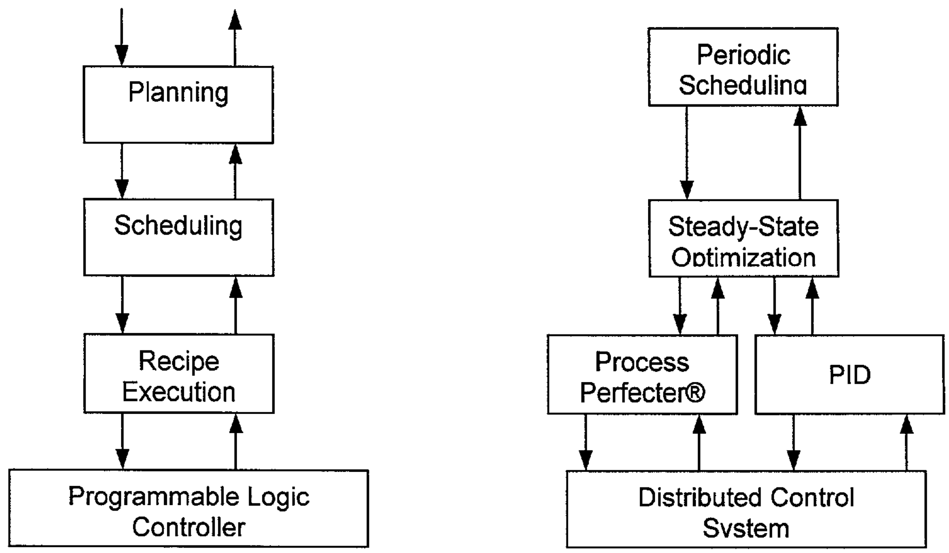
Model Aggregation

Aggregate heterogeneous combinations of model components ...



... treat encapsulated aggregate as another model

Figure 12

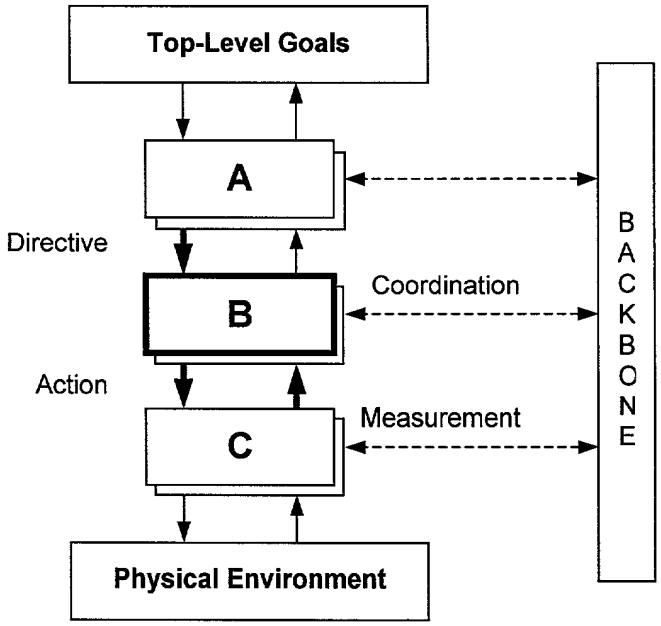


Typical Batch Operation

Typical Continuous Operation

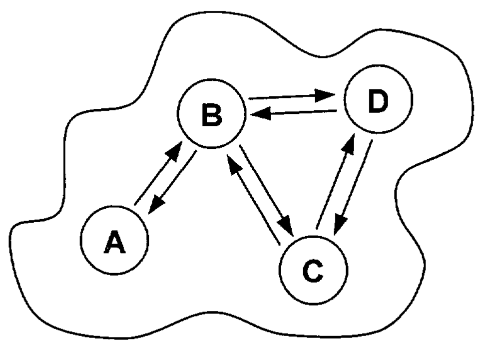
Examples of traditional
decision-making hierarchies

Figure 13



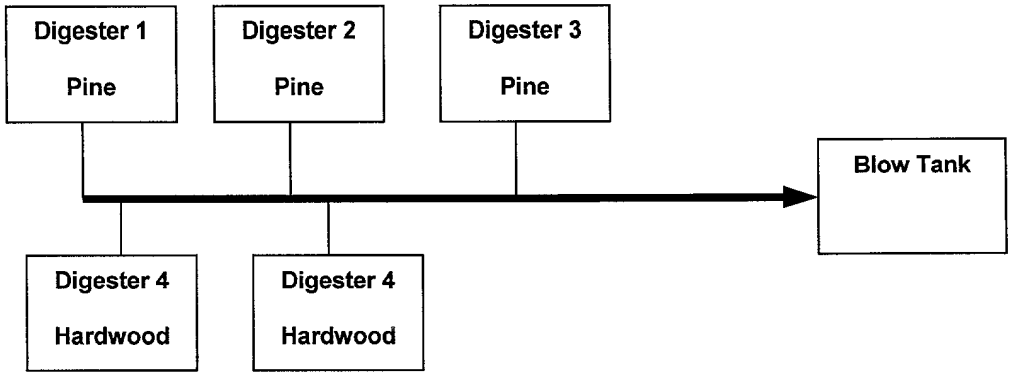
Flexible decision-making hierarchy

Figure 14



Non-hierarchy decision-making network

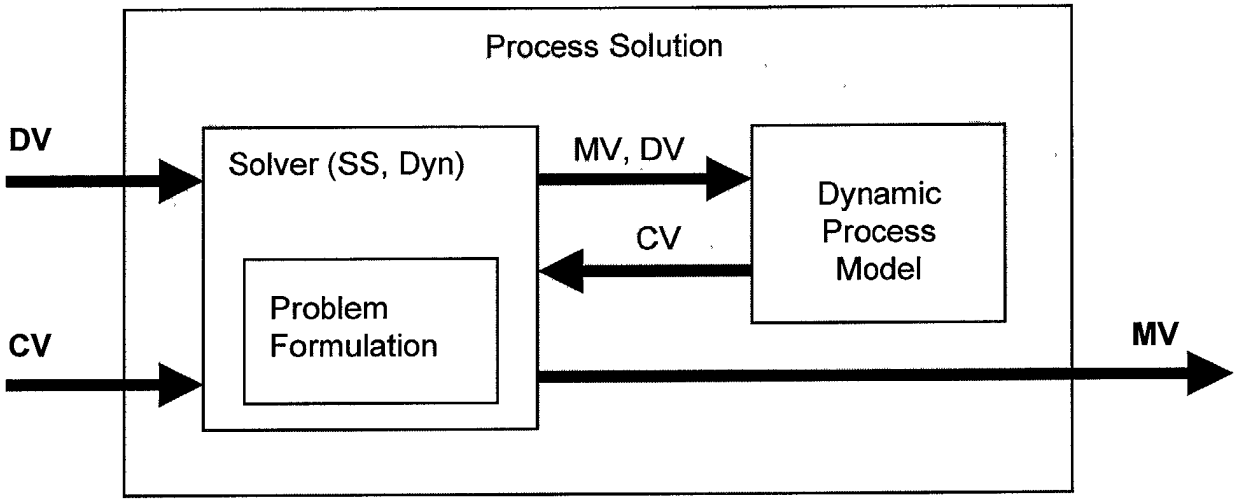
Figure 15



Digester line

Figure 16

Flexible Solution Formulation



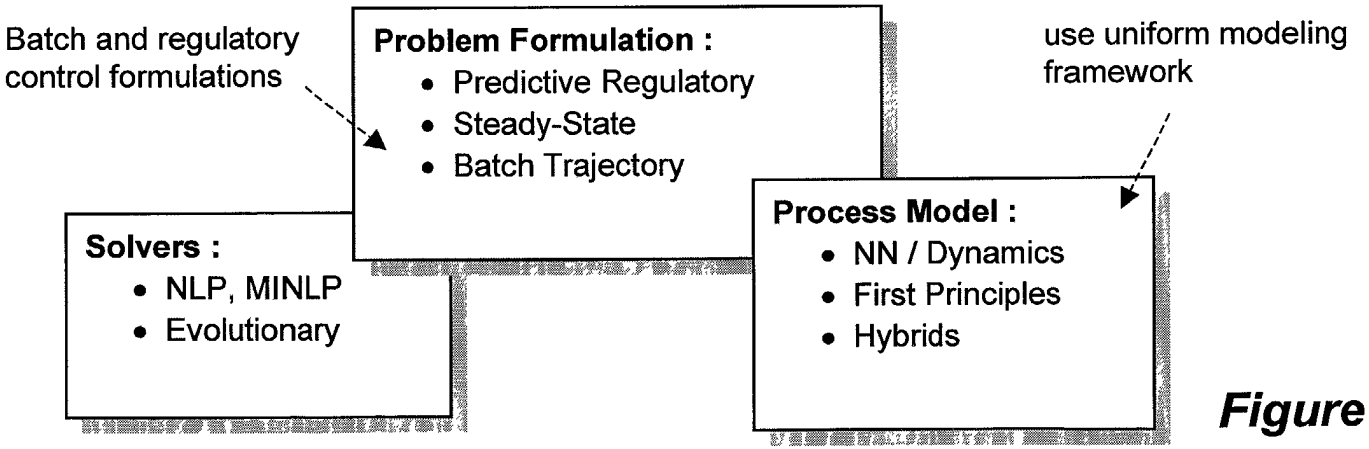
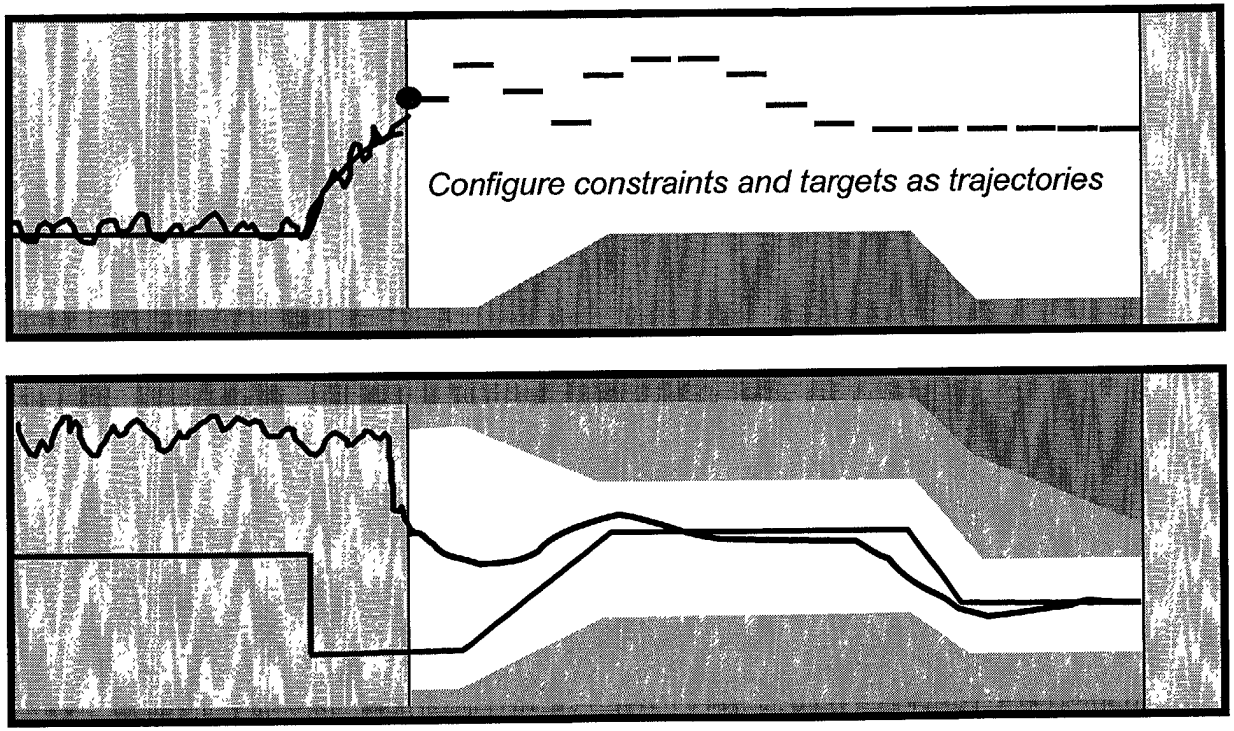


Figure 17

Flexible Dynamic Optimization



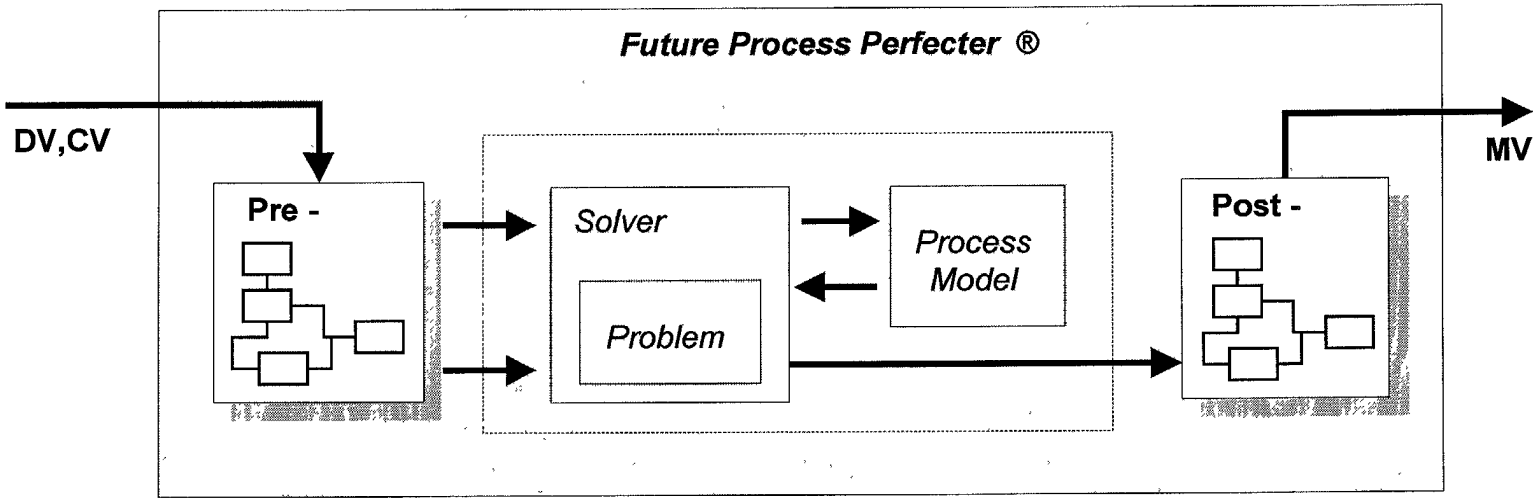
Allow dynamic predictive control over a

- ⇒ *shrinking horizon for batch-phase trajectory control,*
- ⇒ *receding horizon for set-point regulation*

Figure 18

Embedded Data Processing

Aggregation of models and Decision-Engines allows processing to be embedded within a controller ...

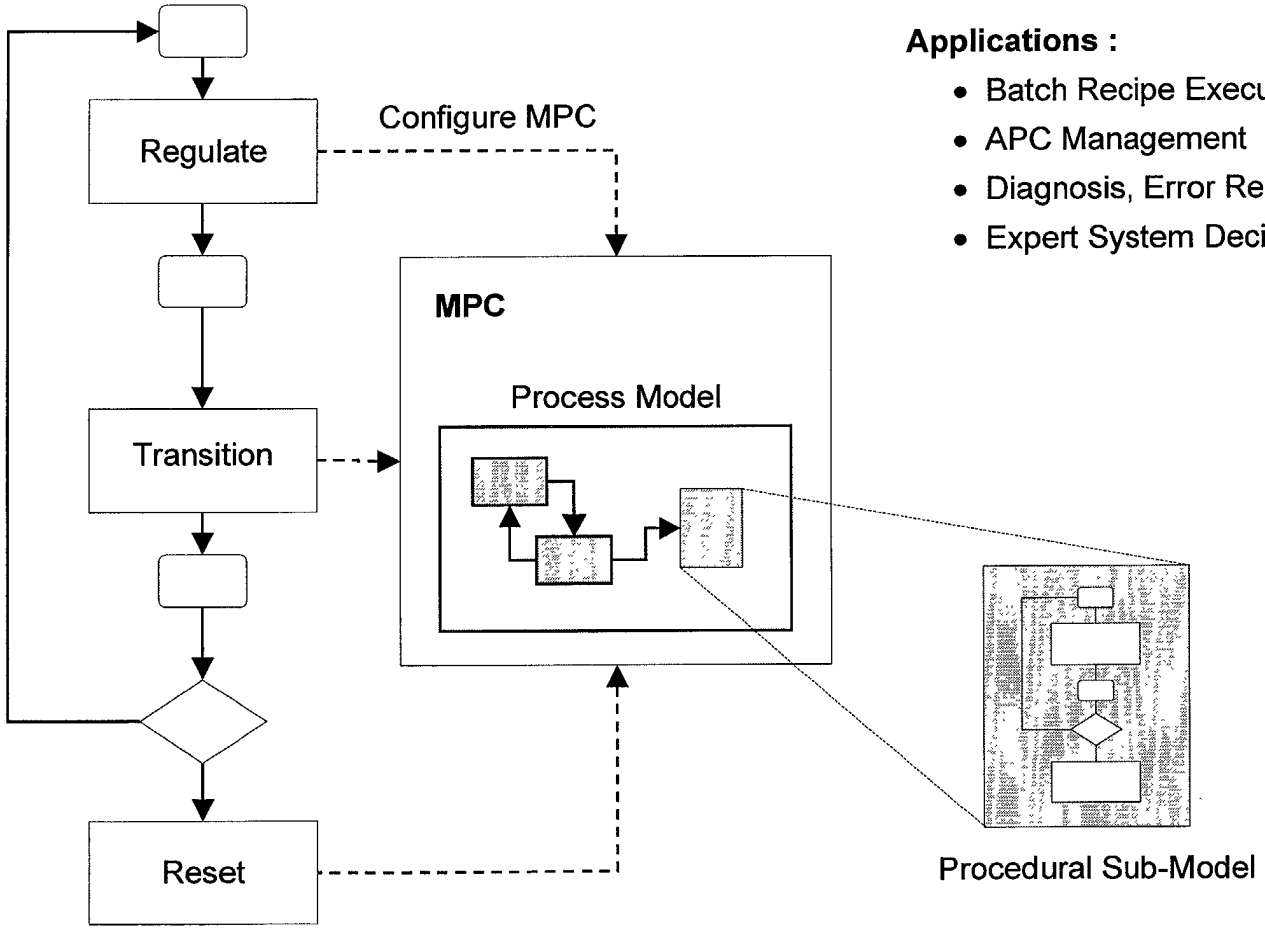


Embedded Processing for :

- Non-Linear transformation
- Feature creation
- Process estimation (VOA®)
- Error handling

Figure 19

Treat Procedures As Models



Applications :

- Batch Recipe Execution
- APC Management
- Diagnosis, Error Recovery
- Expert System Decisions

Figure 20

Solutions Interact Within Framework

"Integrated Decision-Optimization Network"

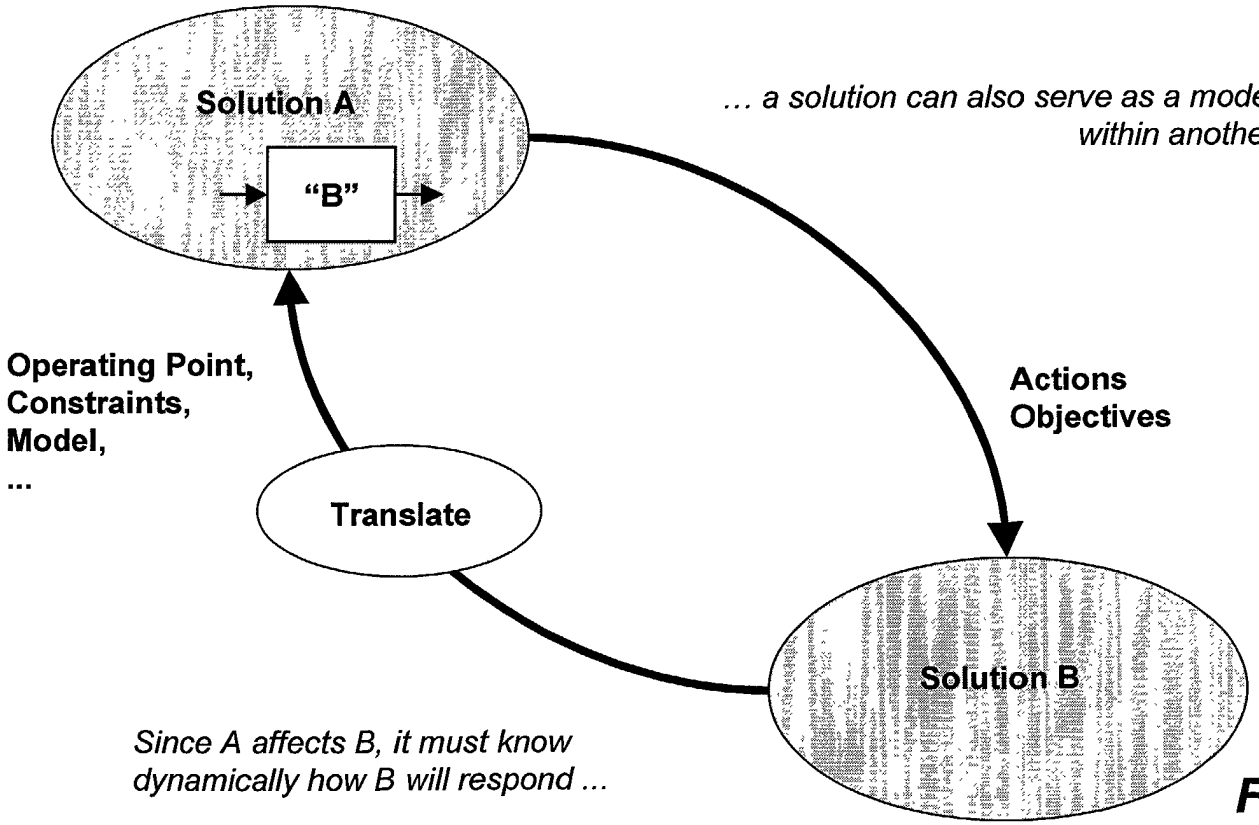
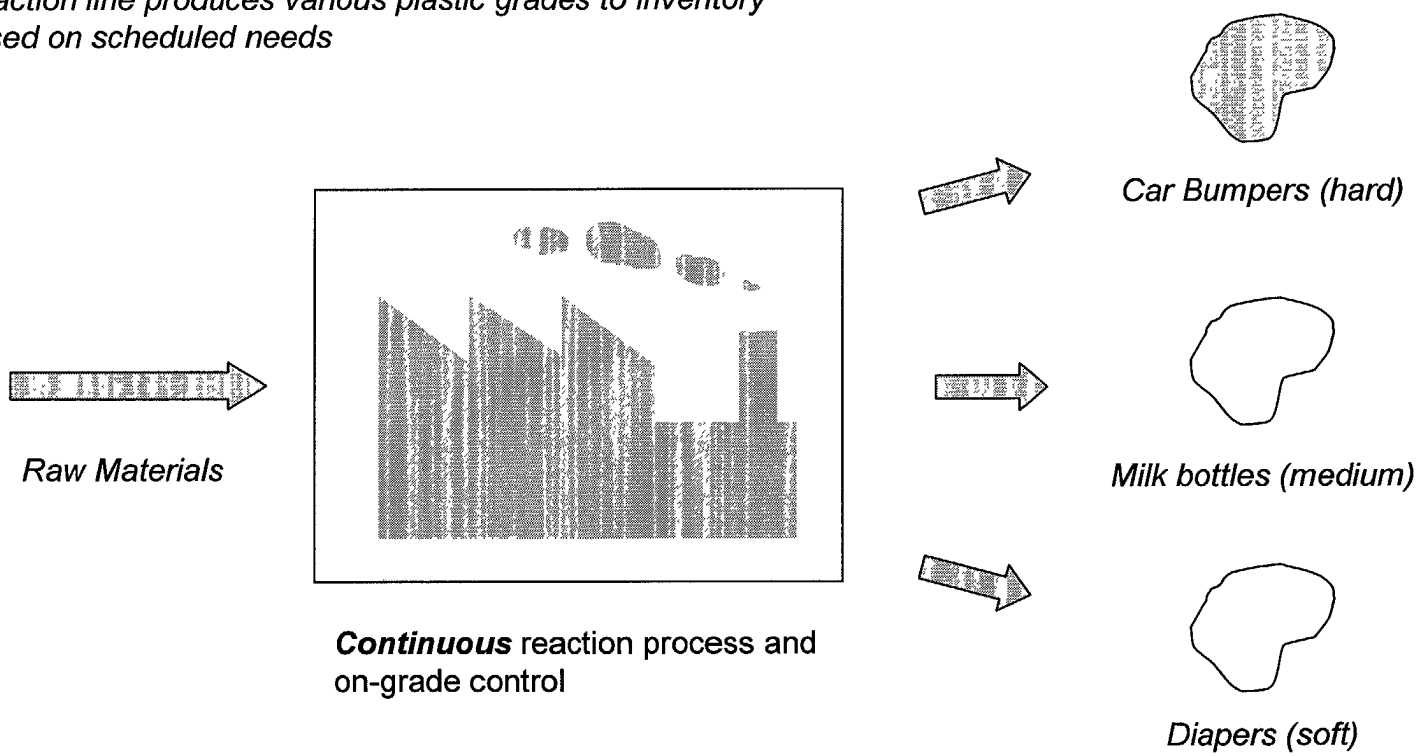


Figure 21

Polymer Production Example

Reaction line produces various plastic grades to inventory based on scheduled needs



Continuous reaction process and on-grade control

Batch characteristics of lot handling and and configuration automation

Figure 22

Traditional Approach

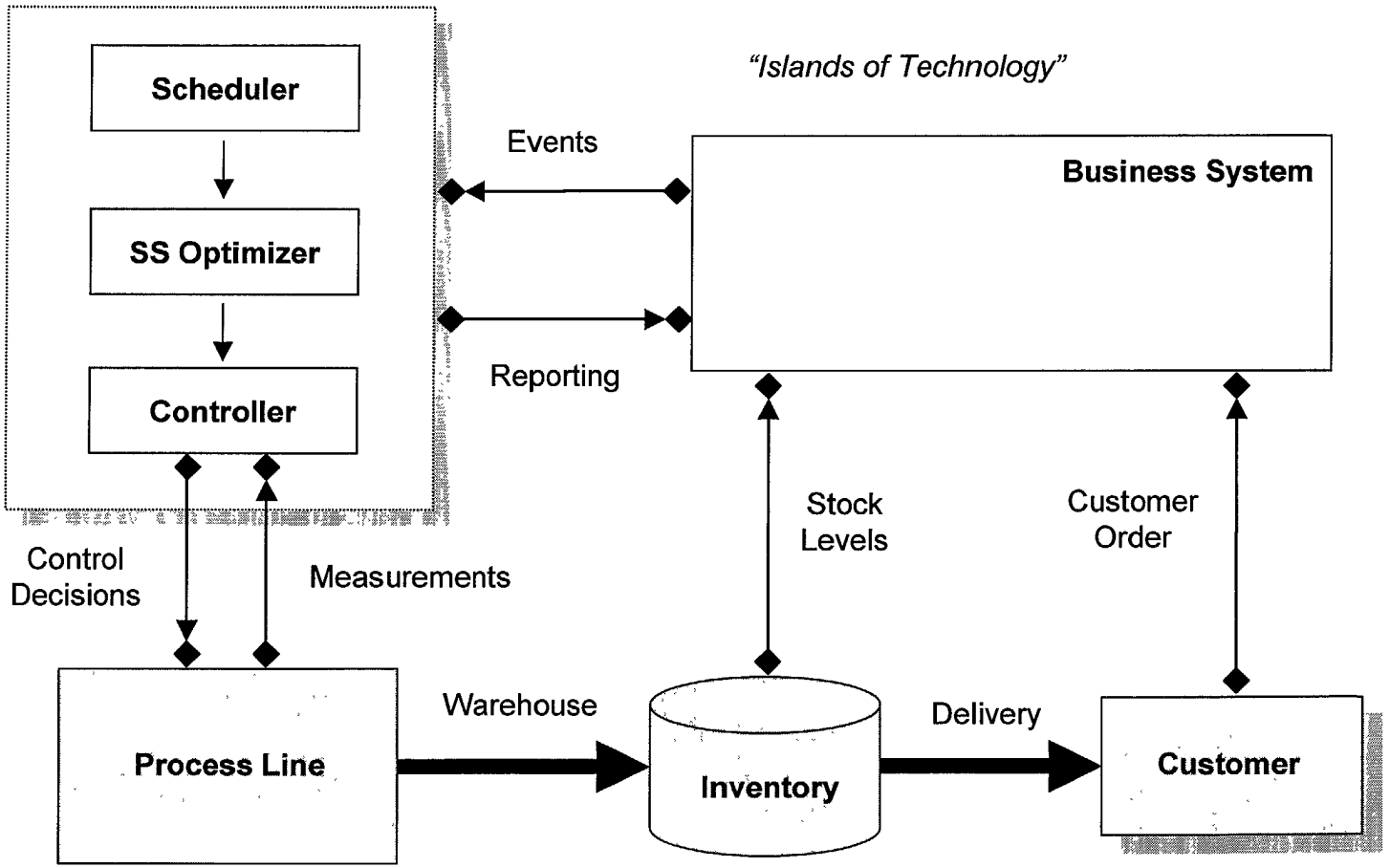


Figure 23

Process Coordinator

"Integrated Decision-Optimization Network"

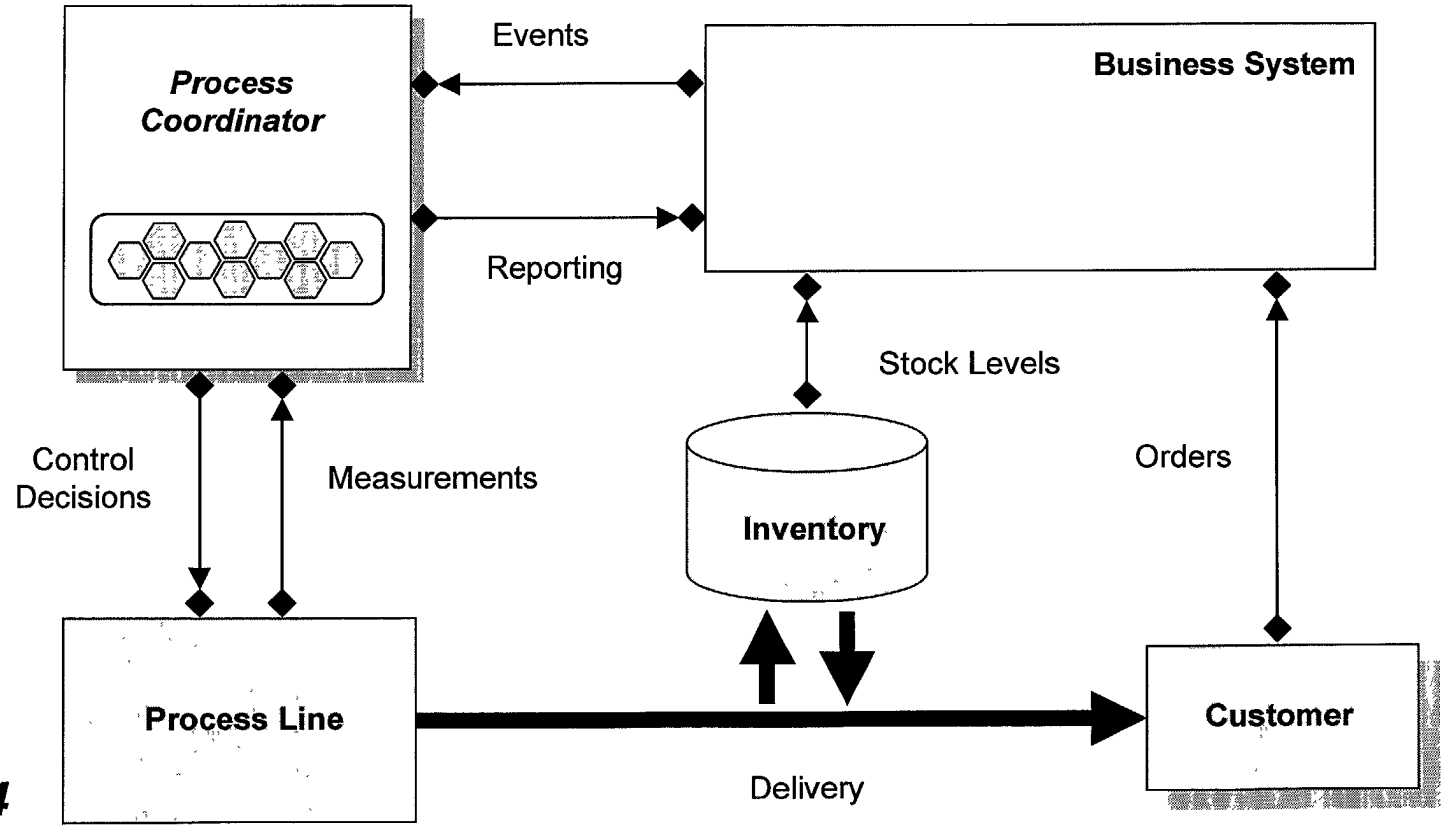


Figure 24

Traditional Production Scheduling

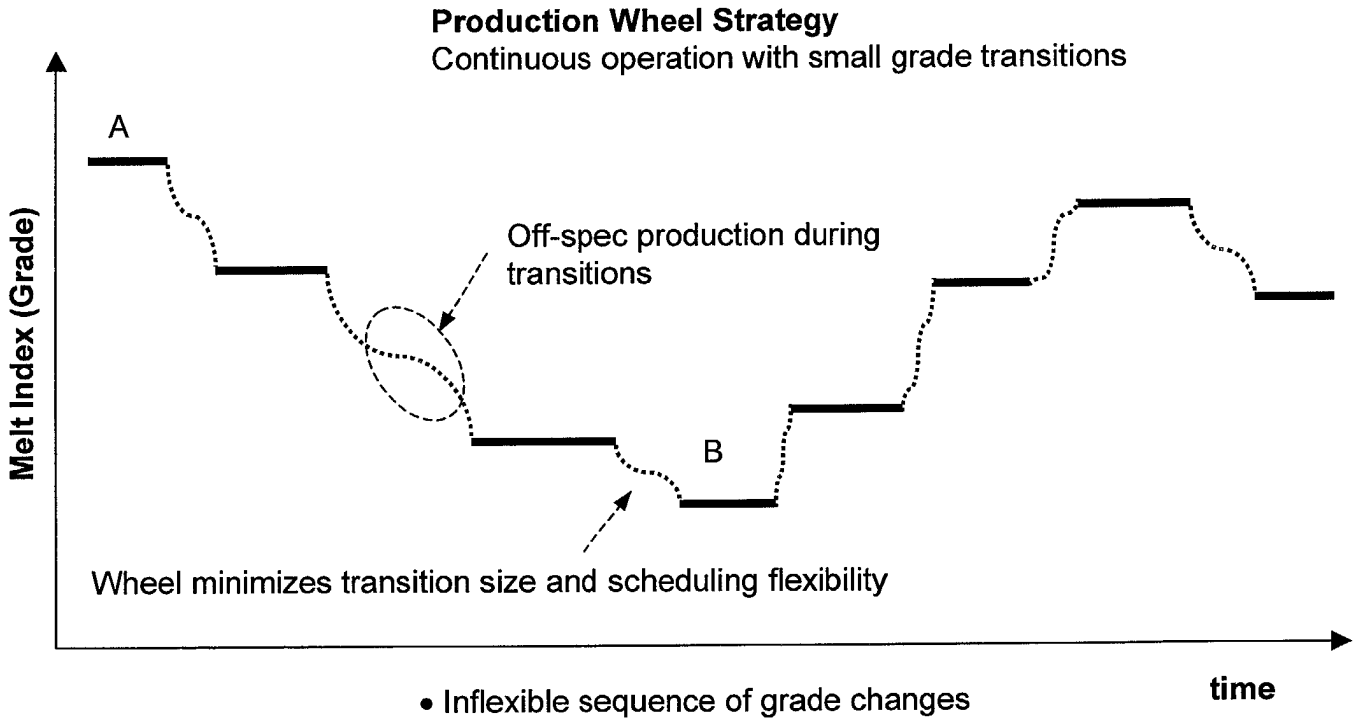


Figure 25

Flexible Grade Scheduling

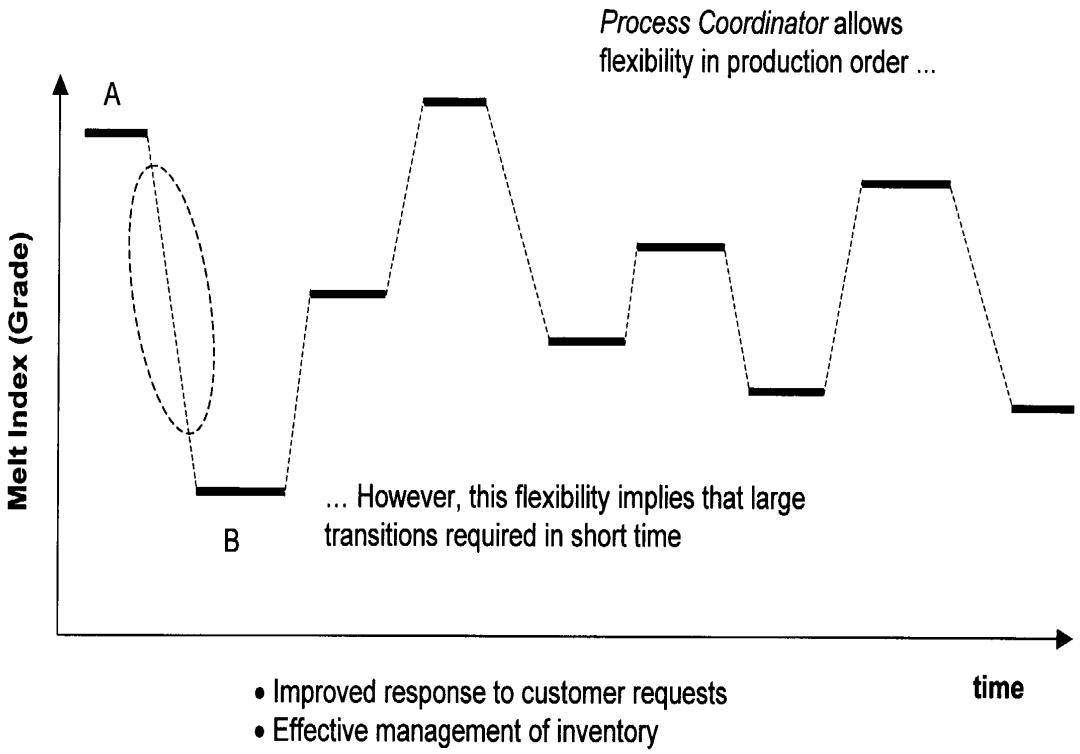
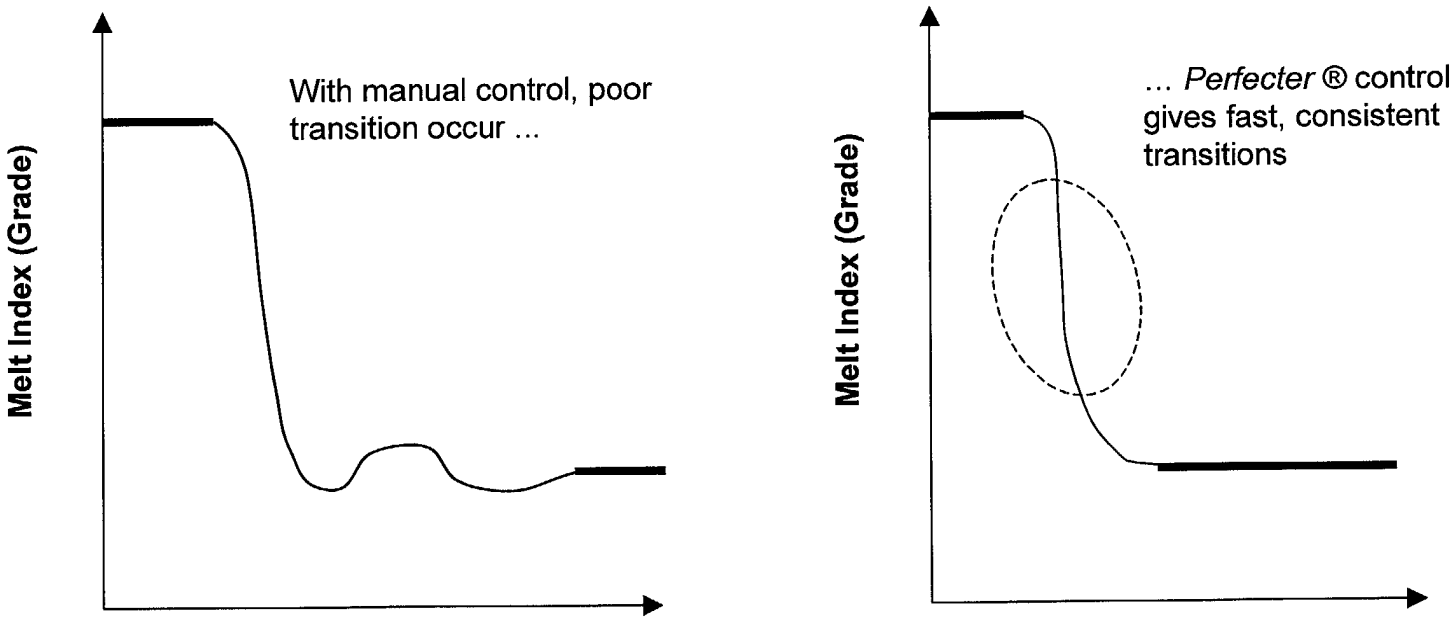


Figure 26

Control Enables Flexible Transitions



Process Perfecter ® technology, which combines non-linear optimization and control, enables large, rapid, consistent transitions necessary for flexible scheduling.

Figure 27

Dynamic Models Provide Behavior

Unified dynamic models allow *Process Coordinator* to compute optimal decisions based on accurate costs, constraints, and predicted impacts.

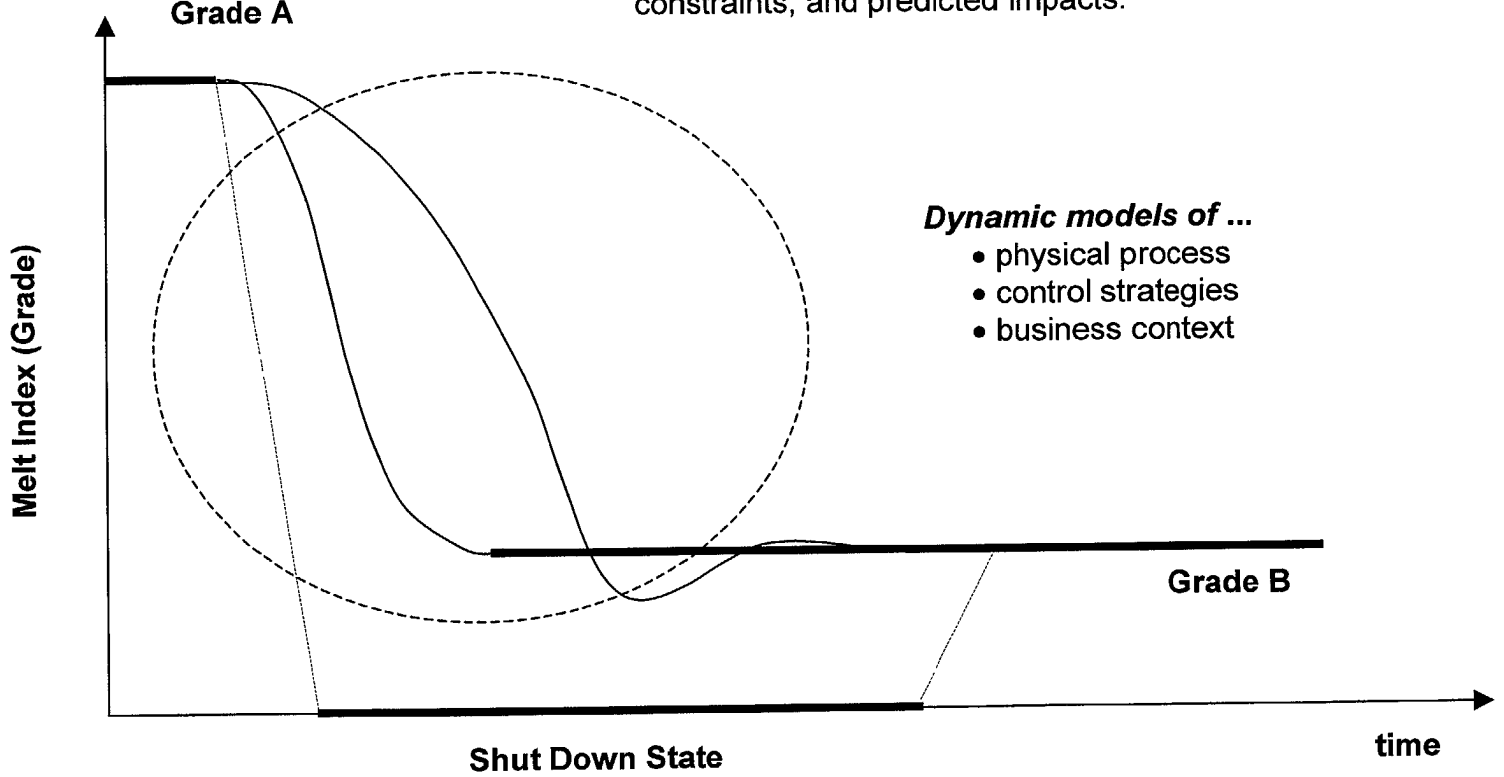
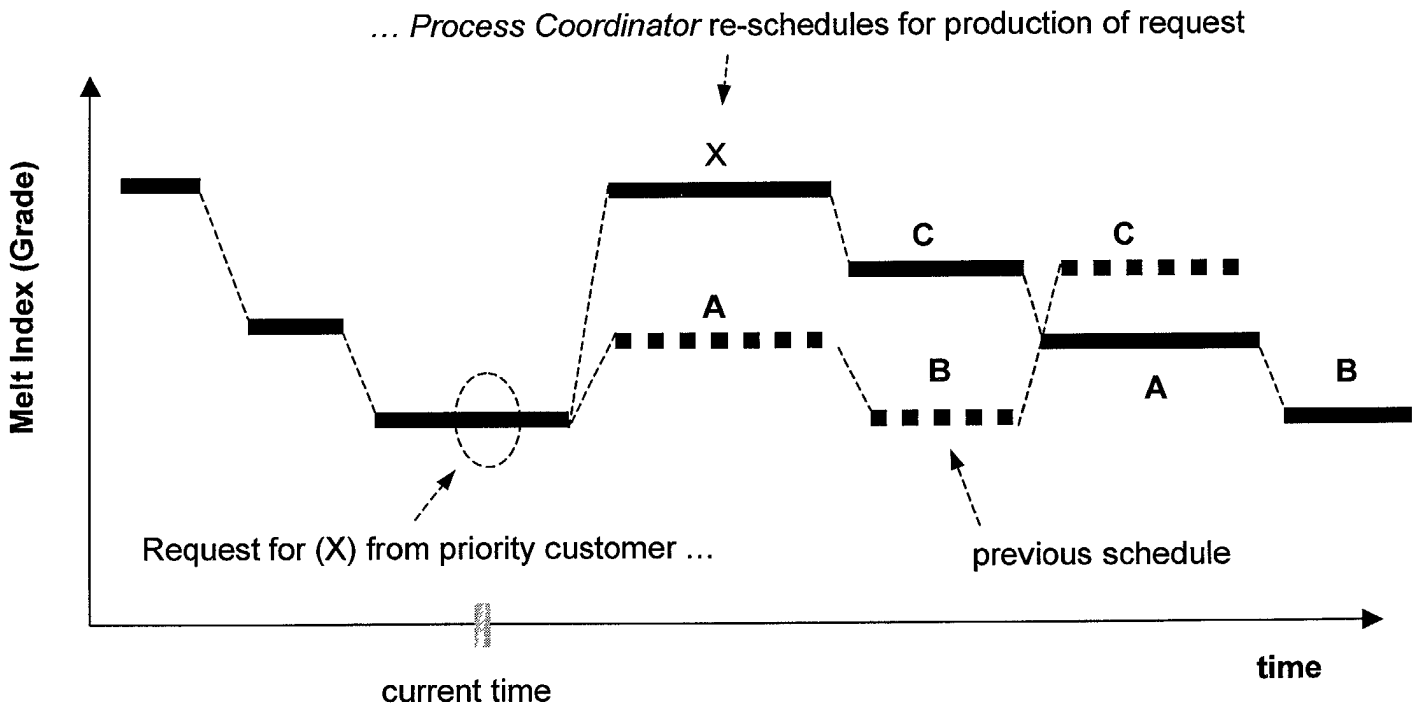


Figure 28

Event –Triggered Re–Scheduling



- Actual impact of request-fulfillment is known
- Down-stream scheduling re-optimized

Figure 29